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MENTAL ARITHMETIC.*

By Amy Pridham.

We are very happy to-night in having Mr. Sonnenschein as our chairman, for I think it is not too much to say that he has helped to revolutionize the teaching of arithmetic in our schools. I suppose there is no one in this room who has not seen, or at least heard of the apparatus worked out by Mr. Sonnenschein and Mr. Nesbitt for the teaching of numeration, or of the number pictures so much prized in the nurseries and kindergartens nowadays, not to mention these gentlemen's books on the subject.

Arithmetic has always been taught, in fact it is one of the "three R's"; but as a mere art, except for business purposes, it cannot rank equally with reading and writing.

After school days are passed a great number of people only make use of their arithmetic for account keeping, therefore it is not this mere art of working out sums and calculations with figures, that gives to arithmetic the right of being considered one of the primary elements of education.

Indeed, were that all, I should be inclined to agree with those who sigh—

> "Multiplication is vexation,
> Division is as bad,
> The rule of three perplexes me,
> And practice drives me mad."

For when arithmetic is merely taught by rule of thumb, it does indeed become flat, stale, and unprofitable, from an educator's point of view.

What is it then that has given to arithmetic the right to so honourable a place, at all times, in all civilized countries? How is it, that in a book dedicated to Edward VI. by Robert Recorde, we find this quaint praise:—"It is an art, that the further you travell the more you thirst to goe on forward. Such a fountaine that the more you draw the more it

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* Paper read for the Hampstead Branch of the Parents' National Educational Union.

springes, and to speak absolutely in a word (excepting the study of divinity, which is the salvation of our souls) there is no study in the world comparable to this, for delight in wonderfull and godly exercise: for the skill hereof is well known immediately to have flowed from the wisdom of God into the hearts of man, whom he hath created the chiefe image and instrument of his praise and glorie."

Surely there must be some very good reason, and I hope to prove to you that there is, and that we ought to be as enthusiastic in the 19th century as, at any rate, one master was in the 16th.

This evening I want to show how the teaching of mental arithmetic can be used to train our children in mental habits which shall lead to steadfast, accurate thinking; how it may serve as a discipline for the powers of attention, concentration and abstraction, and how it may help to train them to a love of independent and honest work.

All members of the P.N.E.U. are well aware that in the first instance we get all our knowledge through the senses; now, Mental Arithmetic is no exception to that rule. Therefore the little child, just beginning, must work in the concrete. He must see, hear, touch, and I might almost add taste and smell number.

To take some very every-day examples from home life, Mental Arithmetic is beginning when you play at "This little pig went to market." When you divide an orange for distribution among the little ones. When you say *one* shoe is missing of Tommy's best pair. When the children help lay the nursery tea and count the things wanted. All that is unconscious preparation; without such preparation the regular systematic teaching (which should begin as soon as a child appears to show signs of wanting to number his surroundings) would be sadly hampered. The child will have to learn the names of numbers, but the names of the numbers must not be divorced from the things that are numbered, therefore let him count with real things, buttons, bricks, anything you like; but do not teach him to count high numbers. One, two, three will last a long time. When he can show you one brick, or three, or two as you ask for them, try whether he can imagine other things numbered with the help of bricks, finally try if he can do without bricks altogether by such questions as—If there were three little children in one room, two of them boys, how many girls? One. If you had one rose and wanted three how many more must you pick? Two.

You will not care to have any more of such simple examples, but I want you to notice that as soon as the child has grasped the faculty of abstracting the numbers one, two, three, discard the concrete, but by all means give him concrete again when you take him further on; and now I am going at this point to be a little heterodox. I do *not* think at the very early stages you should discountenance the habit of counting with the fingers; if properly trained the child will soon discard it.

Now for a slightly more advanced stage. Children will work readily with mental pictures in this way:—Walking down a street there is—

A policeman,
A dog, and
A butcher's boy.

How many creatures?
How many legs?
Why?

Require a fully-worded answer. The boy and the man had two legs, the dog four, so that though there were only three creatures there were eight legs.

How many more tails than legs were there in the street?

Twist and turn your questions about; it produces great alertness and a sense of brightness. Children are essentially play-loving animals, and you must not disregard this if you want them to love Mental Arithmetic. Questions such as these will delight the little ones, whereas if you said the same thing in a dull way you will produce stolid children. The little exercise just given involved addition, multiplication, analysis of number and subtraction, and might have been given so:—

Add $1 + 1 + 1$
Multiply 3×2
How much is 4 more than 2.

I will ask you to judge which method is suitable to a little child.

It is a good plan in preparing these little exercises to keep the four rules well in mind, *e.g.*, Division: A boy had eight chestnuts and four friends, he shared them equally, how many each? Multiplication: There were three little girls, they each sang two songs, how many songs altogether? etc. For children at this stage, and even younger, it is a good training to get them to shut their eyes and listen while you clap your hands a certain number of times, or strike notes on the piano, in different rhythms.

It is very important that the children should themselves set such exercises, not always the teacher. After a time the children are only *too* ready to do so. In fact I heard of one house where the parents, whose children had become very keen on the subject, positively had to forbid them setting arithmetical problems for their elders, or themselves at meal times; no doubt this was out of a very right and proper consideration for the digestive organs.

In the initial stages of teaching Mental Arithmetic a good deal of language-teaching is necessary, for example such words as—single, double, both, couple, pair, half, brace, duet, twice, thrice, triplet, third, quarter, dozen, score, addition, subtraction, equal to, contained in, etc., all must be taught. These words will never be a puzzle to the children if they are introduced to them in some such way as this:—Two little boys were *both* given a ball, one had a red, the other a blue one. How many boys had a blue ball? How many boys had a red ball? How many boys had balls? If there were three children to have balls should we say they *both* are to have one? No. Why? One more example:—There was a woman once going to sell eggs at a market, and she counted them over and put them together in heaps of ten and twenty, and she called every big heap a score and every smaller one half-a-score. How many eggs had she in the big heaps, how many in the little? If she sold a score of eggs how many would that be? Suppose somebody wanted a dozen, how many less would that be than a score? Would half-a-score be more or less than a dozen?

All words or terms needed for Mental Arithmetic must thus be made perfectly clear, in order that the children may have no difficulty with the material of their question. This is a subject in which a sure foundation, in all its branches, is of infinite importance.

My experience of children has led me to believe that if they have been thoroughly drilled in the low numbers, that is to say can add, subtract, divide, multiply and give the simpler fractional parts of any numbers up to 9, in all possible ways, without any calculations in written figures, all future work has had a good road paved for it. My reason for stopping at 9 is, that though the children do not work with written figures they certainly should be taught the symbol for the number they use, and the answer to Mental Arithmetic questions should often be written instead of given orally; in class teaching this is, of course, an immense save of time.

Before giving any mental work in numbers above 10, I think concrete lessons in numeration should be given, that children should be *shewn* not *told* how many farthings make a penny, how many pence a shilling, etc. The same plan should be followed with the *useful* weights and measures. I do not mean that all this must be done at once, but I want to insist that, just as the babies counted one, two, three, with their buttons or toys, before you gave them abstract questions, so the older children must go the same way. It will be found to be a fatal mistake if a step is left out here. Go *very slowly* is a safe rule if you want to get rapid and accurate work later.

With this preparation it will no longer be necessary to be so graphic in your questions as you were to the little ones; gradually the questions may become severer, as the children begin to enjoy working simple problems for the satisfaction of their own mental activity. The four rules can now be taken with higher numbers—separately and then mixed. For example—

+ Think of $7 + 3 + 8 + 2 + 9 + 7 + 4 + 3 = 43$.
  Think of $\frac{1}{2}$ doz. + $\frac{1}{3}$ of 18 + $\frac{3}{4}$ of a score + $\frac{1}{4}$ of a hundred = 52.
− Think of $23 - 4, - 3, - 2, - 1, - 3, - 2, - 1 = 7$.
  Think of $\frac{1}{4}$ of 12 − $\frac{1}{4}$ of 8 + $\frac{1}{4}$ of 16 + $\frac{1}{4}$ of 20 = 10.
× Think of $2 \times 2 + 2 \times 3 + 2 \times 4 + 2 \times 5 = 28$.
÷ Think of $24 \div 2 \div 3 \div 2 = 2$.
  Think of $3 \times 5 - \frac{1}{4}$ of 20 + 10, double it + $\frac{1}{3}$ of 6; how many people could have 7 units each = 6.

I need not give you any more such examples, for all could make them for themselves.

As well as questions on the four rules it will be found useful to give numeration questions to be done mentally. *E.g.*—

In 5,000 how many thousands?
hundreds?
fifties?
twenty-fives?

How would you write down?

3,776? 3,076? 3,006? Etc.

Marketing sums are great favourites.

A boy had 2 florins.
He spent 3*d.* for a top
1*d.* ,, string
2*d.* ,, note-book
6*d.* ,, butterscotch
1*s.* ,, in the money-box;
had he anything left in his purse? 2*s.*

A man spent 7*s.* 6*d.* a week on rent,
how much a month? £1 10*s.*
,, ,, ,, year? £18.

I will not weary you with any more examples, but weights and measures should be treated in the same way. There are one or two more ways of dealing with the subject I should still like to bring before you.

Rapid adding and subtracting is a useful accomplishment, and one in which boys and girls quickly learn to excel. There are many ways of practising this. I have found this useful:—Tell your pupils to add a certain number, say 13, to any number you give them, thus: 24, answer 37: 18, answer 31.

Children will soon find out which are the easy numbers to add and subtract. On no account *tell* them, let them find out for themselves.

This will be the right place to mention the multiplication table. No modern teacher will, for a moment, think of teaching it by rote; but after the children have made up their own multiplication table, and discovered with joy that there are really only 36 answers practically in it. Dodging with the multiplication table is a good exercise, for it is necessary to have it at the tip of the tongue. A very favourite exercise and one requiring a good deal of steady concentration is what we call *unpicking*—

Think of $20 \div 4, \times 3, \div 5, \times 6, \div 2, \div 3$. Answer, 3.

What had you before 3, 9; before 9, 18; before 18, 3; before 3, 15; before 15, 5; before 5, 20. When this is easy leave out "before"—

Think of $\frac{1}{4}$ of 12, $-\frac{1}{4}$ of 8, $+\frac{1}{4}$ of 16, $+\frac{1}{4}$ of $20 = 10$.

Now unpick, 10, 5, 1, 3.

With a class of children it is very stimulating. To let each member join in giving part of a question, which shall be answered by the one whose turn comes last, thus making a chain of thought. Whenever I see signs of flagging attention I use this as a resource, and so far it has been unfailing.

We cannot in a consideration on the teaching of Mental Arithmetic neglect to notice those many devices given to us in all text-books on this subject for quick methods of working; perhaps the most familiar example of this is:—"To find the price of a dozen articles call the pence shillings and call every odd farthing threepence."

I see no objection to such rules provided each child is skilfully led to discover them afresh for himself, otherwise they are not useful as a mental exercise, but thus treated they certainly are a great save of time in practical life.

I have tried to show in a very simple manner, dealing only with the elementary rules, that Mental Arithmetic can be made to produce—*Fixed attention*, *Independent work*, *Promptness*, *Exactness*. It is very early learnt that "nearly right" won't do in this subject, and you will all agree that to train our children in accuracy is of importance for every department of life.

A RATIONAL LESSON.

By S. De Brath.

The end of instruction is not the imparting of knowledge! It seems well to preface an attempt to explain what it is by this paradoxical statement, because the contrary proposition is accountable for nearly all the mistakes of honest teachers. To "instruct" (*instruere*) is to build up—not knowledge—but the mind. It alone can be instructed. It is not a rag-bag for storing odds and ends, nor even a set of pigeon-holes where every item finds its fit place, but a living thing, and the characteristic of life is "function," action. To every intellectual problem which comes before us in daily life, we bring nothing but more or less acute perceptions, more or less alert reasoning, and more or less habit of resolution. Apart from duty and love, which are less matters of instruction than of education, the effectiveness of our action in face of life's daily tasks, will be in direct ratio of the degree to which these faculties have been developed. Putting aside for the present Willing, that motor power which uses circumstance as its raw material, let us consider for a few moments how the mind can be instructed—built up—so as to acquire quick perceptions and the habit of sound reasoning.

The notion that instruction is "storing the mind" with information, is at the root of the whole cramming system, unavoidable when true instruction has been neglected, and an examination looms near, but inexcusable as part of the normal course of education. Teachers endeavour, often with great pains, to give to their pupils the conclusions they have themselves arrived at, and the information they have themselves acquired, but it does not seem to strike them that the more correct and unassailable these conclusions are, the more passively receptive the mind of the learner is likely to become. To have the thinking done for them by the teacher, and to accept with careless assurance the results of that